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ABSTRACT

Students at Glasgow College who were learning mathematics in the traditional lecture/tutorial situation were compared in an experimental study to those learning mathematics using a computer aided learning (CAL) tutorial. Questionnaires were given to the students to determine both their previous experience of computers, CAL, mathematics, and network theory, and their attitudes toward CAL. At the end of the investigation all of the students were requested to assess their understanding of the subject matter and interest in the teaching mode, and the same attitude survey was administered to detect any changes. Results indicated an overall lack of motivation among the students for mathematics and no difference in performance between the lecture/tutorial group and the CAL group. Students felt that the CAL program was better for reviewing old material than for learning new topics. It is concluded that observed differences in individual learning styles appear to be the dominant factor in student learning, and that a mode of delivery that adapts to such individual styles is essential for learning effectiveness. (4 references) (DB)

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AN INVESTIGATION OF STUDENT'S LEARNING ACTIVITIES:

A Comparison of Tutorial CAL and Traditional Methods

by

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March 1990

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AN INVESTIGATION OF STUDENT'S LEARNING ACTIVITIES: A COMPARISON OF TUTORIAL CAL AND TRANDITIONAL METHODS

Sue Milne*, Jean Cook*, Edward Shiu*.

ABSTRACT

A comparison study of students learning in the traditional lecture/ tutorial situation or with a Computer Aided Learning (CAL) tutorial has been carried out. The students' reaction to their teaching material and their scores on post-tests were compared. The lectures were recorded to provide examples of explanations and interactions for use in an Intelligent Tutoring System.

INTRODUCTION

An Intelligent Tutoring System (ITS) is being developed, using a blackboard-type design [1,2] in which the component subsystems are capable of being modified individually. Network Theory has been chosen as the domain for the prototype system because its knowledgebase needs a restricted set of rules and prerequisite mathematical knowledge is minimal. A CAL package for Network Theory including Critical Path Analysis has been written.

A study of students learning Network Theory provides insight into the areas which cause difficulty and the ways in which the problems can be overcome. Some of the students being studied used the CAL lessons, the rest had traditional lectures. The results of this formative evaluation of the CAL package suggest improvements which can be made to the existing package and for facilities which ought to be available to users of the ITS.

EXPERIMENT

The students taking part in the study were on the following courses: a post-graduate Diploma in Systems Analysis and Design (DSAD), the second year HND in Accounting (HNDAC) and the second year BA in Public Administration (BAPA), all at Glasgow College.

Questionnaires were given to the students to determine their previous experience of computers, CAL, mathematics and Network Theory, and to find out their attitudes to CAL [3,4]; the Eysenck Personality Test was also administered to them.

The DSAD class encompassed students with a wide variety of academic backgrounds. A small number of students with prior knowledge of Network Theory were assigned to a CAL revision group. The rest of the class was divided into two groups of equal size, such that the number of people with SCE Higher Mathematics and above was the same for each group, as mathematical experience may affect the student's ability to cope with the notation used in Critical Path Analysis. The other classes were much smaller and were split by assigning names from the class register alternately to each group.

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One half of each class was given the normal lectures, these being recorded by audio-taping the lecturer and class; the other half of the class learnt using the CAL lessons. To avoid contamination of the results the students were asked not to communicate about Network Theory or CAL with the other groups. The activities of the students were observed and the difficulties which they experienced were noted. The CAL groups were asked to comment on the user interface and to make suggestions for improvements to the latter and the lesson content.

At the end of the investigation all the students were requested to assess their understanding of the subject matter and interest in the teaching mode, and the same attitude survey was administered to detect any changes. The tutorial examples usually given to the classes were used as a post-test. The results of the end of term examinations will be used to determine whether there is a difference in the longer term retention of the topic between the various groups.

RESPONSES TO QUESTIONNAIRES

Analysis of the questionnaires showed that few of the students had any previous experience of CAL; many had not used a computer before and some were known to have misgivings about the system. There was a very broad spread of mathematical experience especially in the DSAD class, and at least one student had problems because she was not familiar with algebraic notation.

Analysis of the pre- and post-attitude surveys indicated a positive shift for the CAL groups; the lecture/tutorial groups, as expected, did not show any change in attitude. The more motivated and maturer postgraduate groups were most positive in their reaction; the less motivated HNDAC group were less enthusiastic although their overall change in attitude was favourable. On the whole the group who appeared to find CAL most satisfactory were the DSAD group who had no prior experience of Network Theory.

The aspects of CAL which drew favourable comments were the ability to learn at their own pace and the facility to go back to a topic if there was a problem. The most common complaints were the lack of hard copy notes for revision, the feeling of being under pressure caused by displaying time and score for each section on the menu, and having to restart a complex example if it had to be left before completion, however these are all easily corrected. Of more concern are the requests for clearer explanations, which imply that some students need further or different explanatory material. Several people requested that more examples of increasing complexity be provided for practice.

RESULTS OF POST-TEST

Neither the CAL nor the lecture groups in HNDAC and BAPA performed well on the set examples; both classes exhibit a lack of motivation as far as mathematics is concerned. The personality data did not correlate with the test scores for BAPA and HNDAC. An initial inspection of the test scores for the DSAD groups shows no difference in performance between the lecture/tutorial group and the CAL group who had done no previous Network Theory.

DOMAIN SPECIFIC PROBLEMS

In Network Theory there are several stages at which difficulties arise. The usual problems such as trying to represent an activity by a node of the network rather than by an arrow, extraneous start and end points and incorrect use of dummy activities all occurred among the students being studied. Another fundamental difficulty in the early stages is the translation of the textual representation of dependency to its equivalent diagrammatic form. There is no evidence that these problems were more common in any particular group.

INTERIM FINDINGS

1. The CAL package used in this study appears to be as effective as the traditional methods.

2. A majority of students felt that CAL was better used for revision than for learning new topics.

3. Opinion was divided on the statement "CAL will never be successful until you can ask the computer questions." However, some students agreed emphatically with this view and this was echoed in the responses to the open ended questions.

4. Student learning styles are influenced by background in terms of course, previous experience and motivation. Even though this was expected, the observed differences appeared to be the dominant factors in student learning.

CAL aims at the typical student, and as a result of our observations, we conclude that a mode of delivery which can adapt to individual learning styles is essential for maximum effectiveness.

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